



Communications
Research Centre
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Industry Canada

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Communications Research Centre Canada
Leading the way in telecommunications R&D


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Strategic Plan



Canada

CRC



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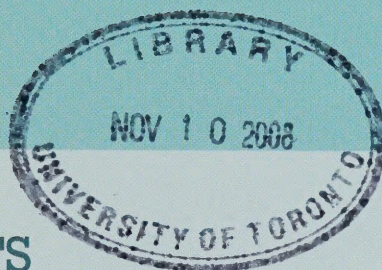


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1. SUMMARY

VISION

The vision of the Communications Research Centre (CRC) is to provide national leadership in collaborative research and development on innovative communications, broadcasting and information technologies for a strong Canadian knowledge-based economy.

MISSION

1. To be the federal government's centre of excellence for communications R&D, ensuring an independent source of advice for public policy purposes;
2. To support government operations led by major clients in selected areas of ICT application such as national defence, public safety and space-based communications;
3. To identify and close the innovation gaps in Canada's communications sector by engaging in industry partnerships, building technical intelligence, supporting small and medium-sized high technology enterprises and working with other research organizations across Canada.

VALUES

- Research Excellence
- Scientific Integrity
- Commitment to Clients
- Respect and Fairness
- Teamwork and Open Communication

GOALS

- Provide support to Industry Canada priorities related to the ICT sector;
- Provide support to ongoing and emerging government priorities;
- Develop working relationships with other organizations to leverage expertise;
- Improve the commercialization of intellectual property;
- Apply the highest standards of scientific excellence.

STRATEGIC ACTIONS

Improve the R&D effort related to Industry Canada's medium and short-term problems.

Identify links between research activities and their potential applications.

Develop more working relationships with other government departments that are potential users of ICT.

Increase cross-Canada marketing efforts for the CRC IP and technology portfolio.



"It's impossible to overstate how important the telecom industry is to our competitiveness, our productivity and our living standards. Our very future as a developed nation is increasingly dependent on information and communications technology."

Maxime Bernier, Minister of Industry, Address to Canadian Telecom Summit, June 13, 2006.



2. INTRODUCTION

TELECOMMUNICATIONS IS AN IMPORTANT ECONOMIC ENGINE FOR CANADA

Prosperity and Competitiveness:

- The telecommunications sector is one of Canada's largest industries;
- Telecommunications provide fundamental infrastructure for private enterprises and public services that use ICTs to design, develop and distribute their products, serve their customers and operate their businesses;
- Telecommunications services represent the largest component of Canada's ICT industry;
- As a high-technology sector, ICT-related companies employ many highly skilled people.

Security and Safety:

- Telecommunications provide critical infrastructure for national security and disaster recovery, enabling rapid communication between individuals, families, businesses and governments.

Overcoming Barriers:

- With one of the highest rates of broadband penetration in the world, Canadians are using ICT to expand business, learning and employment opportunities in remote areas, and for people facing social isolation.



From basic telephones to high speed Internet, Canada has always been at the forefront of making affordable communications services available to everyone regardless of location.

CANADA IS A GLOBAL LEADER IN TELECOMMUNICATIONS

Canada has a history of leadership in telecommunications, both in the development of innovative products for the worldwide market as well as the domestic deployment of communications and broadcasting services.

The telecommunications landscape, however, is constantly changing and competition from other countries for innovative products, marketplace share and ICT deployment is increasing. Developed countries such as the USA, Finland, France, South Korea and Japan continue to make significant investments in ICT innovation. Emerging economies like India, Brazil and China are also making rapid progress in this area.

Important policy and regulatory changes are underway in Canada and around the world to make better use of emerging ICT products and applications, and to allow more ICT growth and competition within countries.

It is in this context that CRC is renewing its strategic plan for the next three years.

A recent report of the Council of Canadian Academies identified ICT as one of the four top areas of Canadian S&T strength. Some concern was expressed, however, that Canada is losing ground to other countries.

Source: The State of Science and Technology in Canada, Survey and Main Findings, Council of Canadian Academies, September 2006.

Telecommunications Services represent the largest component of Canada's ICT industry

- GDP: 2.6%
- Capital expenditures: 2.9%
- Revenues: \$32.9B (2003)
- Jobs: 120,000 jobs (2004)

Source: Telecommunications Policy Review Panel, Final Report, 2006.



3. TELECOMMUNICATIONS RESEARCH IN CANADA

Telecommunications research in Canada consists of four major players: industry, academia, government laboratories and 'fourth pillar' organizations. Each has its own distinctive role and each has made major and complementary contributions to Canada's successes and world reputation.

3.1 Industry

For industry, the total R&D expenditures of the Canadian ICT goods and services producing sector was about \$5.2B in 2005, representing 38 percent of total Canadian R&D spending and 41 percent of research personnel.¹ Obviously, money and effort spent on industrial research directly results in products for the world marketplace and contributes to Canada's economic standing.

3.2 Universities and Colleges

Universities and colleges train and develop the highly qualified personnel required by businesses, and academic research can lead to scientific breakthroughs that eventually can be exploited by industry.

3.3 Government

Research and development activities conducted in government laboratories such as CRC are normally aligned with the mandate of the parent department to support policy development, regulations, standards and social good. In many cases, results of research are also licenced to industry as a spin-off benefit.

3.4 Fourth Pillar Organizations

Fourth pillar organizations such as CANARIE and CMC Microsystems provide a facilitating and catalytic role among the economy's three traditional pillars: industry and business, universities and colleges, and government. They are typically structured as independent, not-for-profit entities, and leverage private and public investment to implement shared-cost R&D programs, build shared R&D infrastructure, and supply technical products and services.

1. Statistics Canada, Science Statistics, June 2005

4. EMERGING CHALLENGES IN ICT

4.1 Evolution of the Internet

ICT is constantly evolving and with this evolution comes new challenges that both industries and regulators must face. Perhaps the biggest disruptive change over the past two decades has been the evolution of the Internet as a major vehicle for communication. Once primarily used as a data transmission vehicle for the research community, the Internet is now used by a majority of the population to communicate with each other, seek information, conduct business and receive entertainment. This development has also impacted the type of work being done within research organizations such as CRC.

Although work continues on analog, digital and optical technologies to make the delivery of information faster and more efficient, there is also a requirement to have a significant amount of resident expertise in information management, networking and applications.

4.2 Convergence

The adoption of all-digital systems and the expansion of the Internet are creating a convergence among the various information and communication technologies: computers, communication networks and broadcasting. This so-called Triple Play implies that all data, voice and video services will finally converge in an IP-based Next Generation Network. As defined by the Internet Industry Association (IIA) Convergence Virtual Taskforce,



convergence is about the collapse of disparate technology, equipment and services into a set of common and ubiquitous technology, equipment and services. The effects will strongly influence the businesses of the involved players, with the power to make companies vanish from the market, but also to help companies blossom.

4.3 Increasing Availability of Broadband

The growing availability of affordable broadband is enabling access to new services and applications. It is also creating high expectations that information will become available instantaneously anywhere it is needed or desired. Many countries in the world have adopted a policy of deploying broadband so that all citizens will have some form of access. Each country is different and in Canada, a main challenge is the delivery of cost-effective service to a large land mass with a sparse population base. However, this remains an important goal so that all Canadians – particularly those in rural and remote communities – can connect to key services and global business opportunities. There are also tremendous opportunities for the development of new applications as well as cost savings to governments resulting from the delivery of services such as education and tele-health.

4.4 Growing Demand for Portable Wireless Devices

Canada and the world are experiencing an explosive demand for portable wireless devices to access an increasing number of applications. These devices have evolved from pagers and cellphones with the ability to access Internet, e-mail and video, with even more capabilities on the horizon. More spectrum-efficient technologies, as well as solutions related to connectivity and user interface, must be developed to meet this growing demand.



Most of the changes in the communications infrastructure are now applications driven.

4.5 Growing Demand for Bandwidth

In the area of spectrum management, significant challenges are emerging as a result of increased demand for bandwidth for civilian, defence and public safety applications, increased sharing among different uses and applications, and need for harmonization within Canada as well as between Canada and other countries.

4.6 Security and Privacy

Security and privacy in online communications are primary concerns to companies and individuals alike. Decades ago, one needed a physical wiretap to infiltrate a communications network to obtain confidential information. Today, a personal computer located anywhere in the world could achieve the same result. Online threats such as identity theft, fraud, viruses and network attacks are also increasing. Emerging technologies such as radio frequency identification (RFID) could become a further challenge to privacy.

4.7 Interoperability

Terrorist events have highlighted the requirement for interoperability of communications for law enforcement agencies and Industry Canada has some responsibility for emergency preparedness as related to the spectrum. Solutions will involve increased co-ordination between law enforcement and other agencies of government involved in public security as well as technological advances in areas such as software defined radio.

4.8 Copyrighted Material

The illegal distribution of copyright material has already created a significant problem for the music industry. The Canadian Recording Industry Association (CRIA) estimates that 35 percent of music CDs sold worldwide in 2003 were pirated products, accounting for sales losses of approximately \$4.5 billion US. In Canada, the CRIA estimates that sales of pirated sound recordings drain \$23.5 million CDN from the legitimate Canadian market. A similar situation is emerging in the broadcasting and entertainment industry in which, as the CRIA notes, Canada now holds the dubious distinction of being a world leader in the pirating of movies that are camcordered in theatres.

4.9 Lagging ICT Investment and Worker Shortage

ICT investment per worker in Canada is lagging behind the United States, which affects Canada's industrial productivity relative to other countries. The ratio of ICT investment to GDP for Canada's business sector was only 66 percent of that of the U.S.



The Information Technology Association of Canada (ITAC) commissioned a study last year with the Centre for the Study of Living Standards to examine why Canadian ICT adoption rates lag so far behind those in the United States. Several factors emerged, including the disproportionately larger number of small and medium-sized businesses in Canada versus the U.S., combined with the fact that SME's typically under-invest in ICT. The study also suggested that structural composition was a factor — the U.S. has a disproportionate share of IT-intensive industries compared to Canada. In looking at ICT investment per worker, the study found that Canadians under-invested in ICT in 15 out of 17 industries. The exceptions were arts, entertainment and recreation, and educational services.²

Compounding this problem is the fact that Canada may also be facing a shortfall of ICT workers. Fewer students chose this area of study after the high technology downturn at the beginning of the decade. Both of these problems will require some remedial action by government and industries.

4.10 Other ICT-related challenges:

- Need for increased use of new communications technologies in non-traditional sectors;
- Power consumption efficiency of devices and networks;
- Increased use of location technologies to customize delivery of information;
- The highs and lows of the Canadian telecom industrial sector; and
- Greater requirement for interdisciplinary research programs.

Industry Canada Program Areas

- Developing industry and technology capability
- Fostering scientific research
- Setting telecommunications policy
- Promoting investment and trade
- Promoting tourism and small business development
- Setting rules and services that support the effective operation of the marketplace

5. INDUSTRY CANADA'S STRATEGIC OBJECTIVES

Industry Canada works with Canadians throughout the economy and in all parts of the country to improve conditions for investment, improve Canada's innovation performance, increase Canada's share of global trade and build a fair, efficient and competitive marketplace.

5.1 Industry Canada's mission is to foster a growing competitive knowledge-based Canadian economy.

5.2 Industry Canada's mandate includes three strategic objectives:

- 1) A fair, efficient and competitive marketplace,
- 2) An innovative economy,
- 3) Competitive industry and sustainable communities.

6. CRC'S MISSION

As an agency of Industry Canada, CRC is one of the country's leading laboratories for research and development in advanced telecommunications.



Return on Investment: A recent study shows that CRC's 'family tree' of over 60 spin-off companies produce about \$1.6B in annual sales and employ over 6000 people – a significant return on investment for the \$40M annual CRC budget.

Source: Economic Payback Analysis – Sales & Employment of CRC Spin-off Companies, Doyletech Corporation Final Report, September 2006.

2. Greater Cost of Underinvesting, article by Paul Tsaparis, Special to Globe and Mail, 27/10/2006

CRC is the only national laboratory with critical mass and expertise in the three major technologies that form the basic transport mechanism for information delivery across Canada: radio, satellite and fibre-optics. CRC's extensive research in these areas includes investigating ways to improve interoperability between systems to form an efficient, seamless communications network.

In fulfilling these expectations, CRC provides leadership in Canada by conducting R&D activities in ICT areas that support the following mission:

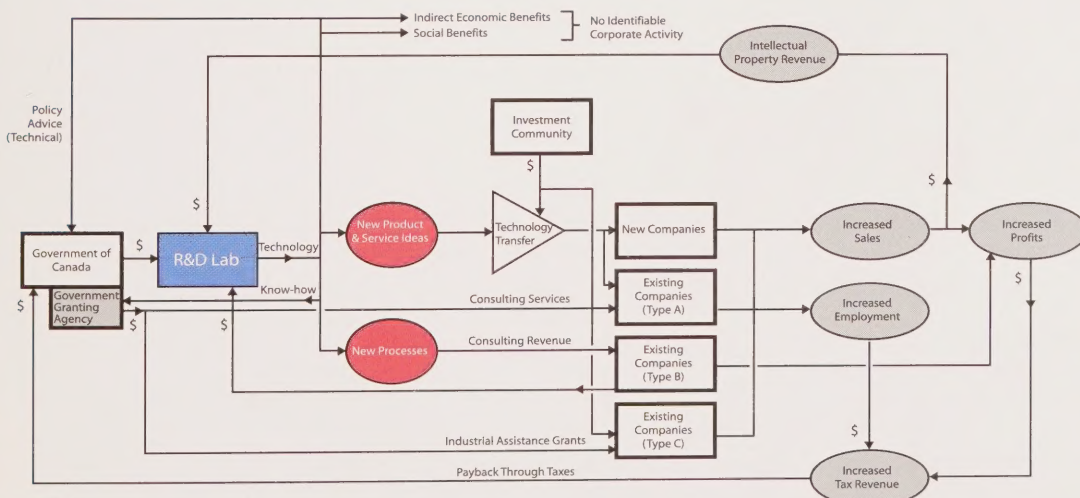
1. To be the federal government's centre of excellence for communications R&D, ensuring an independent source of advice for public policy purposes;
2. To support government operations led by major clients in selected areas of ICT application such as national defence, public safety and space-based communications;
3. To identify and close the innovation gaps in Canada's communications sector by engaging in industry partnerships, building technical intelligence, supporting small and medium-sized high technology enterprises and working with other research organizations across Canada.

Major Roles of Government Laboratories

Research and development activities conducted at CRC are aligned with the mandate of Industry Canada and also adhere to the principles stated in the Council of Science and Technology Advisors' Report, Building Excellence in Science and Technology (BEST), which identifies four major roles that government laboratories must fulfil. These are:

- Support for decision-making, policy development and regulations;
- Development and management of standards;
- Support for public health, safety, environment and/or defence needs; and
- Enabling economic and social development.

Framework for Illustrating the Economic, Social and Advisory Payback from a Government-Funded R&D Laboratory



Notes:

- Type A - Small and medium-sized enterprises (SMEs) that supply technology-based products and services.
 Type B - Multinational enterprises (MNEs) or other government departments that use technology-based products and services.
 Type C - Companies that usually develop their own technology in the form of "know-how" for the grant approval process.

Source: Doyletech Corporation



Benefits to Canada and Canadians

The resulting benefits to Canadians include:

- Improved defence and public safety communications;
- New companies offering expanded product lines and additional employment opportunities resulting from technology transferred to SMEs;
- A more robust ICT sector, generating trade and investment opportunities;
- Knowledge generation through graduate student training at CRC and knowledge sharing via demonstrations of broadband applications that connect educators and students, particularly those in remote regions;
- The development of international standards and telecommunications policy – both of which help bring emerging technologies to market.

7. CRC'S GOALS

To better accomplish its mission, CRC will undertake a series of initiatives and make the required changes leading to the following goals:

1. Provide support to Industry Canada priorities related to the ICT sector by:

- Conducting longer term R&D and providing an in-depth insight and analysis of the impact of new technologies on the sector to support telecommunications policy, regulations and standards development;
- Undertaking short-to-medium term R&D tasks to assist Industry Canada with specific problem areas related to ICT;
- Supporting the development of the ICT industrial sector, specifically by targeting those areas for R&D where a capability gap exists in Canada;
- Providing input to inter-government committees and representing Industry Canada at international meetings related to ICT to support the development of S&T strategies and policies.

Key Result: CRC will be more responsive to ICT sector-related issues faced by Industry Canada.

2. Provide support to ongoing and emerging government priorities by:

- Providing support for ongoing government operations in specific program areas led by major clients;
- Promoting the adoption of ICT as an enabler to assist with some of the emerging national priorities through the conduct of multidisciplinary research in partnership with other departments.

Key Result: CRC research will be better aligned with federal department priorities.

3. Develop working relationship with other organizations to leverage expertise by:

- Intensifying scientific cooperation with other government departments, industries, agencies and academic organizations in order to access expertise that is not available within CRC, particularly for the conduct of multidisciplinary research;
- Developing partnerships with organizations in other countries in order to share information on worldwide developments that can affect Canadian telecommunications and identify marketing opportunities for Canadian business.

Key Result: CRC will access greater critical mass of facilities and expertise to undertake multidisciplinary projects within Canada and with other countries.

4. Improve the commercialization of intellectual property by:

- Continuing to play an important role in the development of the ICT industry sector through technology transfer, industrial partnerships, knowledge transfer by training highly qualified professionals, and by working with companies using CRC's IP or facilities (including the CRC Innovation Centre);
- Improving knowledge of CRC expertise, technologies and IP portfolio by increasing marketing efforts, directly promoting CRC across Canada and enhancing the information available on the web site.

Key Result: Canadian industry will have an increased industrial knowledge of CRC's IP portfolio leading to more commercialization opportunities.

5. Apply the highest standards of scientific excellence through:

- Continuous improvement in research planning, reporting, assessment and management.

Key Result: Improved governance and accountability.



8. CONSULTATIONS AND PROGRAM DEVELOPMENT

Although CRC has a substantial amount of freedom in selecting research activities that form its core competencies (mainly through information gathered by participating in the international research community), the strategic priorities are determined by consulting with various stakeholders. This is accomplished by:


- Seeking advice from the CRC Board of Directors comprising heads of major client organizations, IC senior management and the Canadian industrial and academic community;
- Holding an annual strategic planning session;
- Conducting directed research tasks for Industry Canada on specific spectrum and broadcast issues;
- Conducting directed research tasks for the Department of National Defence (DND) on specific military communications issues;
- Managing of major satellite communication programs on behalf of the Canadian Space Agency;
- Participating on Industry Canada management committees at various levels;
- Participating with Industry Canada and DND on national and international standards and regulatory bodies as technical experts;
- Participating on Canadian government working groups such as those related to public safety and network security; and
- Chairing/participating in international standards technical committees and conferences.

9. MISSION-CRITICAL SCIENCE ACTIVITIES

CRC focuses most of its scientific research efforts and funding on five main core competencies:

1. Wireless systems (terrestrial and satellite communications)
2. Communications networks
3. Radio fundamentals (propagation)
4. Interactive multimedia and broadcasting
5. Photonics (optical communications)

Some of the facilities and expertise associated with these core competencies are unique in Canada and even North America.



About 25% of CRC's research effort is spent on core research activities with a view to building intellectual capacity. It is important to spend these resources to maintain a technical knowledge base for foresight – both to address client issues and anticipate ICT sector direction in the longer term.

Strategic Priorities

With significant input from its major clients and its Board of Directors, CRC has identified six strategic priorities to define the major elements of the research programs and associated activities:

9.1 Broadband Access – CRC will support the federal government's goal of connecting all Canadians. Research activities focus on delivering cost-effective broadband solutions to rural and remote communities – innovations that could be replicated in other parts of the world.

9.2 Radio Spectrum – CRC will provide Industry Canada with a solid technical base for the development of policy and standards for efficient and effective regulation and allocation of radio spectrum. CRC also supports Canada's participation in international spectrum allocation.

9.3 Defence Communications – CRC will enable DND to make decisions on procurement and deployment of military communications systems.



DND is one of CRC's major clients. Research activities, conducted on a cost-recovery basis, marry CRC's technical expertise to DND's requirements for communications R&D. DND's interests include network-enabled operations with emphasis on research, capacity, interoperability, reliability, quality of service, security and access to radio spectrum.

9.4 Network Security and Public Safety – CRC will provide advice regarding the security of network infrastructure for communications, commerce, defence and other applications. In partnership with other Canadian organizations, CRC is examining the needs and capabilities of technology in this field, including the security of wireless networks. CRC will also develop new technologies for emergency/disaster communications, and search and rescue.

9.5 Internet and Convergence – CRC will provide technical insight into future convergence issues (Internet, wireless, optical, broadcasting) to assist government in making informed policy decisions.

9.6 Applications – CRC will assist content providers and user communities in connecting together and evaluating new tools and applications for social benefit.

It is expected that CRC will continue with these strategic priorities, with an increasing emphasis on linking its research to potential applications.

Much of the growing interest and demand for broadband technology is driven by applications that require a high quality of service. With access to various national and international communications networks, CRC is well positioned to demonstrate the most novel and promising of these applications, such as online education and medical systems, focusing on a high degree of social or industrial benefit.

10. RESOURCES

10.1 Human Resources – CRC has a total researcher and technologist complement of approximately 230 staff, supported by technical facilities such as machine and circuit prototyping shops. Each year, about 40 graduate students and post-doctoral fellows work at CRC. In addition, some 20 researchers act as adjunct professors to Canadian universities, leading to joint supervisory opportunities. These numbers provide CRC with the required critical mass to conduct its research:

- 50 percent of which supports Industry Canada's mandate;
- 25 percent serves other government department clients; while
- 25 percent is spent on core research advancing intellectual capacity.

Because of successful hiring during the telecom downturn a few years ago, CRC has a healthy mix of young and experienced researchers, so the organization is well positioned for succession planning. Many of the senior managers will be able to retire by the end of the decade, but by that time, some of the younger staff will have developed the necessary skill sets to take over. CRC is working with Industry Canada's Human Resources Branch to develop a formal career development program for researchers. If successful, it will be extended to other groups.

10.2 Financial Resources – CRC receives its operating and personnel budget from three major sources: Industry Canada; other government clients; and the private sector, for contracting-in and intellectual property licensing.

The budget is used to support laboratory and equipment maintenance as well as campus operations. Government-wide reductions are testing CRC's capacity to maintain its facilities in good operating condition and deliver on its research programs. CRC will continue to explore:

- Options to balance its R&D with the required support functions; and
- Ways to increase the financial resources for both these activities.

10.3 Shirley's Bay Campus – The Campus provides a secure environment for organizations to conduct classified research or operations. As custodian of the Campus, CRC is responsible for its ongoing maintenance and development. However, its large size and the advancing age of some infrastructure means that maintenance and energy costs are increasing. To offset this, CRC is planning to:



- Attract additional partners – In 2007, some new client construction is slated to begin and two new CRC laboratories will open. Growth enhances CRC's recognition as one of the key research clusters in Canada, and can generate further development;
- Explore an infrastructure upgrade program – CRC will also assess models to enhance shared common services to reduce costs;
- Keep the Campus in a safe, secure and serviceable state, respecting all environmental and safety regulations and policies;
- Ensure recapitalization planning and R&D planning are aligned, and integrated with tenants' R&D plans.

11. PROGRAM DELIVERY

- One of CRC's strengths lies in demonstrating its R&D. Its in-house capacity to fabricate and prototype components and subsystems allows demonstrations of new technical developments in an operational form. CRC's ability to demonstrate complete end-to-end communications systems is particularly important for clients such as DND. For industry partners, it means assuming less risk in advancing a technology. This is just one reason for CRC's impressive technology transfer track record.
- CRC operates a Technology Transfer Office as a one-stop shop for patent protection, as well as for negotiating licenses and partnership agreements.
- An Innovation Centre is available on Campus for new start-up companies.
- CRC researchers promote Canadian capabilities in the ICT sector at major conferences throughout the world.
- This exposure, as well as involvement in national and international partnerships, allows CRC researchers to remain at the forefront of their field and positions them to provide insights on new and emerging technical developments of importance to the telecommunications sector. To take full advantage of this expertise, CRC will publish an annual summary of the state of ICT technology worldwide, with particular emphasis on potential impact in Canada. This summary will complement *Eye on Technology*, the quarterly newsletter showcasing ongoing research projects, and *CRC Highlights*, the annual publication detailing activities of the CRC.
- Scientific publications, technical reports and other forms of documentation and reporting constitute a primary means of program delivery.

12. OUTCOMES (FIVE-YEAR OUTLOOK)

It is anticipated that over the next five years, CRC will solidify its position as the primary federal laboratory for communications research by:

- Developing better working synergies with Industry Canada's needs and priorities;
- Increasing its government department client base, with a focus on ICT adoption, and increasing its overall national presence through additional partnerships and more interdisciplinary research;
- Leading international ICT-related research projects with countries that have potential to purchase Canadian technology;
- Improving identification of linkages between CRC's R&D activities and their potential applications;
- Developing an improved quick-response capability to tackle shorter term problems;
- Improving commercialization of expertise, IP and facilities, including working with on-site partners to establish a dynamic and well-managed research campus, particularly targeted at areas of communications technology that can benefit from shared facilities and a secure infrastructure.

The major outcomes of this strategy and the associated research program are expected to be:

1. Telecommunications policies, regulations and standards will be developed using CRC technical expertise.

This will be measured by the use of CRC inputs (e.g. trends and assessments) by groups developing policies, programs, regulations and standards related to the telecommunications sector including Industry Canada, International Telecommunications Union, IEEE and CRTC.

2. Canadian companies in the telecommunications sector will use CRC-developed technology to improve their product lines and competitiveness.

This will be measured by the number of intellectual property licenses issued to Canadian companies and the sales revenue of Canadian companies in the telecommunications sector that were formed as a result of CRC involvement or through spin-offs from these companies.



3. There will be improved decision-making by National Defence on new technologies related to future military communications systems. This will be measured by the number of technologies that are adopted which enhance or provide new capabilities for Canadian Forces operations, as well as the number of DND Technology Development Programs (TDP), and NATO and TTCP committees led by CRC.

4. The Canadian telecommunications sector will have knowledge of, and access to, CRC's intellectual property portfolio. This will be measured by the number of research partnerships between CRC and private sector, academic and national/international research organizations.

5. More government departments will have knowledge of, and access to, CRC technologies and know-how for ICT-related applications. This will be measured by the number of partnerships between CRC and federal departments.

6. CRC will maintain a high standard of research excellence. This will be measured by the number of scientific publications, conference presentations, patents, technical reports, invited papers, conference chairs and participation in international research consortia.

7. CRC will promote Canadian capabilities in the ICT sector. This will be measured by participation in conferences, collaborations with international organizations, and representation in the S&T community, both nationally and internationally, as ICT experts.

8. CRC will continue to improve its national presence. This will be measured by the number of partnerships with academia, industry and centres of excellence in the Atlantic region, Quebec, Ontario, the West and the North.



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